31. A New Mermithid-worm Parasitic in the Rice Borer, with Notes on its Life History and Habits.

By Tokio KABURAKI and Shigemoto IMAMURA.
Zoological Institute, Faculty of Agriculture, Tokyo Imperial University.
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Through the courtesy of Mr. I. Sugimoto, we had occasion in autumn, 1930, to examine the rice borer, *Chilo simplex* Butler, infested with a certain Mermithid-worm. The infestation of this nema oftentimes attains to a high percentage in the district of Numazu, Shizuoka prefecture. Of 372 rice borers subjected to examination 285 (76.22%) were found attacked by this nema; consequently it may be stated that the nema plays an important rôle in the control of the rice borer.

As will be mentioned later, the nema in question makes its way into the soil, leaving the host body, and attains to maturity. A closer examination of the adults has revealed the fact that the present species, though most closely allied to *Mermis elegans* described by Hagmeier, can be ranged neither under the genus *Mermis* nor under other Mermithid-genera. To our mind, it appears to represent a new genus and species, to which we give the name of

Amphimermis zuimushi n. g., n. sp.

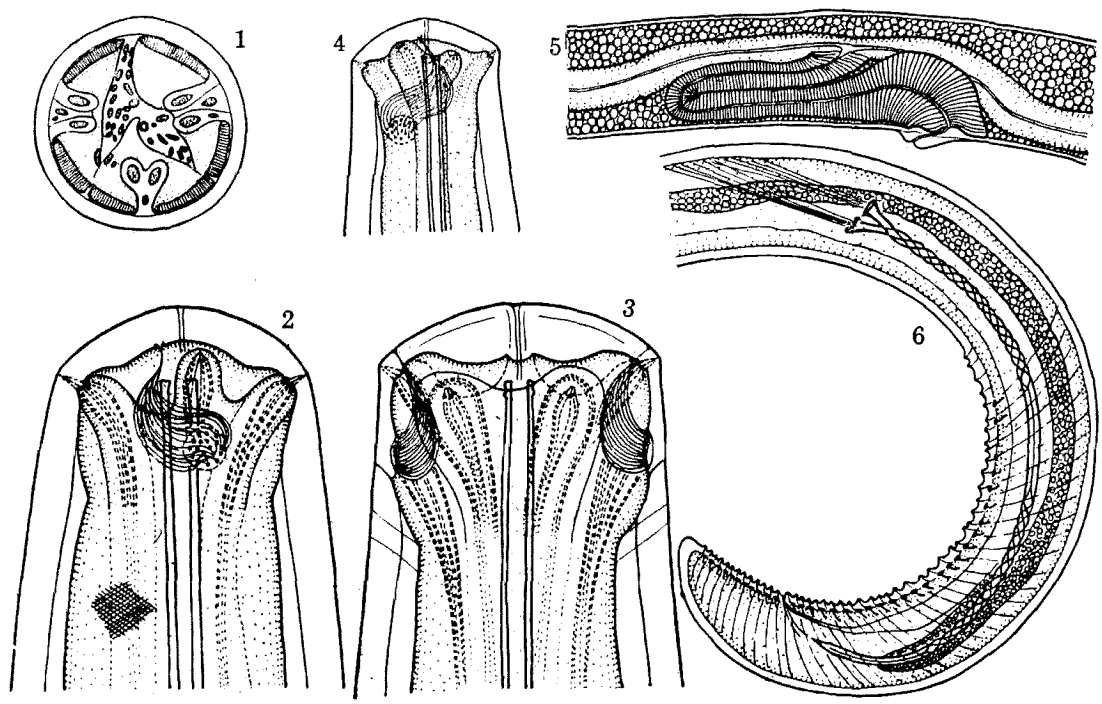
Measurements by Cobb's formula:

		Nerve ring	Vulva	End of fat body	
♀	0.007	0.20	48.16	99.64	174.81 (85.51–232.12) mm. n-10.
	0.067	0.14	0.32	0.25	
♂	0.028	0.53	-M-$^{58.55}$	99.67	52.42 (42.15–88.92) mm. n-10.
	0.053	0.10	0.15	0.12	

Body elongate-cylindrical, tapering abruptly forwards and slightly backwards. Cuticle thick, especially at both the ends of the body, marked with very fine distinct criss-cross fibers. Throughout the body run six longitudinal lines, of which submedian two are the smallest. In the larva left the host the dorsal line is highly developed in the anterior portion of the body but it becomes smaller in the posterior portion, owing to the development of the fat body, and the lateral two are well developed at about the middle of the body.

Here we gladly take the opportunity of thanking the Hattori Foundation for the subvention.

Mouth terminal, leading into the short and slender pharynx; oesophageal tube elongate-slender, chitinized. Fat body extending from behind the nerve ring to near the tail end. Anus absent.



Text-fig. 1. Cross-section through near the anterior body end of the larva left the rice borer.
Text-fig. 2. Head region of the female, lateral view.
Text-fig. 3. Same, ventral view.
Text-fig. 4. Head region of the male, ventro-lateral view.
Text-fig. 5. Vulvar region of the female.
Text-fig. 6. Tail portion of the male.

Anterior end rounded, with two lateral mouth papillae and four submedian head papillae, of which the former are located slightly anterior to the latter. Amphid well developed, kidney-shaped, with 11–19 fibers; its anterior portion slender, opening slightly antero-dorsal to the mouth papilla; the ends of fibers extending farther back in the male as compared with those in the female. Cervical papilla located at a short distance behind the amphid on each side. Nerve ring lying a little behind the anterior end. Excretory pore absent. Ovaries double; one extending forwards, the other backwards. Vulva situated at about the middle of the body and slightly projecting outwards. Vagina very long, S-shaped, of a muscular nature. Female wholly destitute of papillae on the tail. Testes double; one outstretched forwards, the other backwards. Spicula two, yellowish, extremely long, measuring 1.02–1.45 mm., partly twisted, fused together in the distal

part to form a sharply pointed terminus. Anal muscles well developed, extending from the tail end to near the front of the rows of the anal papillae. Anal papillae 82–113 in number, arranged in three rows, extending from the front of the male genital opening to the tail end; median row longer than the others. Tail conical, bluntly pointed at the end, slightly curved ventrally in both sexes. Preparasitic and parasitic larvae never taking off the tail through self-amputation.

Life history and habits.

The infestation of the present nema mostly occurs in the second generation of the rice borer which has two cycles in a year in the greater parts of Japan proper. The rice borer with the parasite is rather inactive and presents in ventral view an aspect exceedingly milky white. Just before the exit the nema attains to a considerable length and is discerned as white bodies extending throughout the host body. Generally it leaves the host at about the harvest time of the rice crop, from the end of October to the beginning of November, and makes its way into the soil, passing through the hole of the haulm made by the rice borer or through the cut end. The exit of the parasite necessarily results in the death of the host. During the winter the nema attains to maturity, casting off once in the soil, and confines itself in the nest. Generally the female occupies a position a little deeper than the male and frequents at a depth of about 30 cm.

In late spring the overwintered male moves about in search of the female and mates with it in the nest. Oviposition takes place from the end of June to late autumn, especially in late summer. Around the worm body are laid vast numbers of eggs which are of a slightly flattened spherical shape and measure 100–110μ in diameter.

After about three weeks at ordinary temperatures of August, the embryo attains to a considerable length. The newly hatched larvae measure 1.55–1.86 mm. long by 0.017–0.019 mm. wide. The body tapers slightly forwards and gradually backwards to end in a hair-like terminus. It is provided anteriorly with a strong boring spear. This free-living larva is positively phototropic, apogeotropic, rheotropic, xenotropic and thermotropic to an adequate warm temperature, as demonstrated by Cobb, Steiner and Christie in *Agamermis decaudata*. In response to these properties the larva makes its appearance on the field surface, and swims about very rapidly in the irrigation water, its greatest speed being about 3 mm. per second. So far as observations go, it is further capable of creeping rapidly even along the glass-wall up to a height of about one foot, making use of the wet surface. It

is therefore forecast that the larva easily creeps on the rice plant, reaches the rice borer, passing through the hole bored by the latter, and finally gets chance to intrude into the host. In fact the nema thrusts its boring spear first into the thin body-wall of the host and completes its penetration for several minutes. The process of infestation appears to happen mostly during the night.

After penetration the nema grows rapidly and remains in the host body for 2–4 weeks. The female is of a tendency to rest in the host much longer than the male. In the larval stage the sexes can be easily distinguished by the presence of the vulva (female) and the genital opening (male). Occasionally there appear some intersexes which bear not only the vulva but the male genital opening as well. According to examination of 64 infested larvae, the sexes appear to be determined by the range of parasitism per individual, as in the following table, in which the number put in brackets represents the intersex.

No. of hosts	No. of nemas per host	No. of females per host	No. of males per host
1	26	0	26
1	22	0	22
1	16	0	16
1	14	2(1)	12
1	12	1	11
1	11	0	11
1	11	2	9
3	10	0	10
1	9	0	9
2	8	1	7
1	8	2	6
1	8	3	5
1	6	0	6
1	6	4	2
1	4	1	3
1	4	2	2
3	4	3	1
1	4	4(3)	0
1	3	2	1
2	3	3	0
3	2	1	1
10	2	2	0
1	1	1(1)	0
24	1	1	0

Here some interest is attached to the fact that in very low parasitism per individual there appears the female only, and the higher the parasitism per individual is, the more conspicuous is the appearance of the male. As to whether the sex depends upon the amount of food, we are not in a position to make any mention. The question deserves further investigation.